2035: How the discovery of ammonia conservation in cancer cells helped natural scientists diagnose breast cancer.

A faultless surgeon able to perform the smallest of incisions. A computer who teaches children better than any human ever could. A friendly neighbourhood robot. As of the 21st century, the application of artificial intelligence has been developing expeditiously. A.I. is being applied to smartphones, vehicles and banking and while 2035 may sound like a considerably distant future it is in fact a fast approaching reality. By 2035 we may develop flying cars, a pathway of communication between animals and humans or even automaton household helpers. However, I believe we should focus on something more constructive to us: medicine, which has flourished due to the application and availability of machinery. As an aspiring molecular biologist, in this essay I will debate a futuristic approach to diagnosing breast cancer by constructing a chemical-specific micro robot capable to detect cancer cells.

Breast cancer is the most common invasive cancer in women. In spite of the fact that awareness for this disease is rising and medical treatment is improving, in 2017 almost 250,000 new cases of breast cancer have been reported with around 40,000 affected likely to succumb to it. The disease is also one of the more common genetic cancers: BRCA1 and BRCA2 amongst others are genes that cause breast cancer. Most women receive diagnosis after a physical change to the breast itself, which can be too late. An effective technique for detecting the cancer quickly could therefore aid many generations of women with the mutation. Hence my idea allows women to be diagnosed without noticing a physical change to the tissue (such as a lump). A 2017 study done by researchers at Harvard Medical School exposed that cancer cells in the breast tissue have been found to have a strange and horrifyingly useful growth technique. Ammonia, a by-product of metabolic waste, previously believed to be toxic, does not affect cancer cells. Moreover, the study showed that breast cancer cells can actually successfully metabolise ammonia into a source of nitrogen for building blocks of amino acids which allow the cells to increase their rate of division. However hideous this ability may sound to some, I will discuss the utilisation of this discovery to identify cancer more effectively with a glutamate complementary micro-robot.

Glutamate is the amino acid which the ammonia build-up in breast tissue is used for. It is one of the most abundant amino acids in the human body, found in the liver, kidneys or cardiac muscle. However, it was found in the 2017 study at Harvard Medical School that 57% of the available ammonia around the breast cancer cells was metabolised into glutamate. This should in theory rapidly increase the concentration of glutamate in the breast tissue. Moreover, glutamate is hydrolysed by the enzyme glutamate dehydrogenase. While envisioning the incredible complexity of this enzyme I figured it must be simple to identify. Enzymes have an active site that forms enzyme-substrate complexes once the two bind. Ammonia is toxic to humans and has to be immediately removed. Thus, if large amounts of glutamate hydrogenase are found in breast tissue it could bring an early diagnosis to a patient and increase caution for family in case of mutation in the genome. And the most reliable way to ensure promising results? A tiny piece of A.I. able to be controlled with visible light, possibly directly on the skin.
To return back to the initial question: what is the role of natural scientists in the development of my idea? A collaboration between many different fields of the STEM industry would have to be encouraged to create this robot. And why a robot? Computer

programming of a robot constructed by robotic engineers makes it compatible and decreases chance of errors. This would not be just any robot but a micro cyborg that can be transported in the bloodstream and detect the culprit- cancer cells. Well not directly cancer cells, but the amino acid cancer cells synthesise from ammonia: glutamate. The amino acid is hydrolysed by glutamate dehydrogenase; therefore, the design has to incorporate a miniature binding site exactly matched to that of the enzyme. This is where biological scientists and robotic engineers combine forces to create a new definition of an enzyme substrate, operated by light which is able to detect glutamate and ultimately the ammonia metabolising cancer cells. A similar concept has been applied recently; introducing Liquid Crystal Elastomers (LCEs), robotic, caterpillar-like systems. Their movement can be projected onto a screen to see whether they are travelling to the area of the tumour controlled by a remote. LCEs incorporate light-responsive molecules into their structure their movement can also be controlled from an external light source, either photochemical or photothermal.

Designing a robot for such a specialised job will be no easy task. The design of the robot itself would be completed by robotic engineers. It must be microscopical and at the same time able to conceal an electronic system inside it to connect to a screen. It should be inserted through an injection and able to decompose by itself. Keeping a synthetic substrate of the enzyme could cause a disadvantage to the patient as the enzyme is still required to hydrolyse glutamate in healthy somatic cells. LCEs are polymers, hence my take on this would be to utilise biodegradable polymers. Diversely, biodegradable materials could fail to survive in the conditions found in the human blood stream. Nonetheless, biodegradable polymers have their great potential applied to the field of medicine. Thus, this is another part of the big research project for natural scientists to consider. Organic chemists exploring different sequences of polymers suitable for conditions inside a human that will also decompose naturally in the human body, (a polymer blend of nylon could be a suitable material). There is a risk of side effects on the health of patients so immunological research should provide a solution to injecting a synthetic substrate into the body. Once the device is implanted and enters the breast tissue I would expect the glutamate dehydrogenase to be present hence form an E-S complex with the robot. The robot signals that on the monitor. This does not identify cancer itself however the doctor can now transfer the patient for further tests to diagnose for cancer by looking for the cells themselves.

In conclusion, this astonishing discovery in cancer research will benefit natural scientists who study uncontrollable mitosis of cancer cells and its environments. Retreating to my projection, once the technique is perfected to identify ammonia producing cancer cells, oncologists will commence the process of treatment of the cancer. Assuming my project functions as proposed, cancer cells will be able to be detected before a noticeable tumour is produced. Naturally my project only considers earlier diagnosis and not treating the disease. As an aspiring scientist myself, I believe biochemists must begin with improving this efficient diagnosis first, as it could prevent more disastrous effects of malignant tumours that spread in the body, something which often is fatal. My idea, however innovative or seemingly unlikely could be applied to the study of cancer and with the incredibly rapid improvement of the STEM industry in the last fifteen years I remain hopeful. No major, inventive idea or discovery has been able to gain respect of others in the field or the public with ease. Thus, it is always more impressive to witness the underdogs, (such as myself) to gain a considerable status, and this is what someday I strive to accomplish someday.